CLAIMS

1. A method for converting a halftone image in which each pixel takes one of two binary values, into an image in which each pixel takes a continuous value, comprising:

for each pixel, defining a respective neighborhood containing that pixel and other pixels;

in a first iteration, obtaining for each individual pixel a continuous value as a weighted sum of the binary values of the pixels in the neighborhood of the individual pixel, the weighting values being derived from the binary values of the halftoned image; and

in further iterations, obtaining for each individual pixel a continuous value as a weighted sum of the continuous values of the pixels in the neighborhood of the individual pixel obtained at the previous iteration, the weighting values being derived from the continuous values obtained in at least one previous said iteration.

2. A method for converting a halftone image having a halftone value for each of a plurality of pixels, into a reconstructed image which for each of said pixels takes more than two values, comprising for successive individual pixels:

defining a set of neighborhood pixels of the individual pixel, the set of neighborhood pixels including the individual pixel and additionally a plurality of pixels proximate said individual pixel;

deriving for each pixel of the neighborhood, a significance coefficient; and

deriving the reconstructed value of the individual pixel as a sum over the pixels of the neighborhood of a product of the halftone image value at that neighborhood pixel with the significance coefficient of that neighborhood pixel.

3. A method according to claim 1 in which said halftone image is derived from an original image having a continuous value for each pixel, and, for each individual pixel, said significance coefficient of each neighborhood pixel is an indication of the likelihood that the value of that neighborhood pixel in the original image is correlated with the value of the individual pixel in the original image.

4. A method according to claim 2 in which, for each individual pixel, said step of deriving a significance coefficient for each neighborhood pixel includes: deriving a

baseline value for the individual pixel, and deriving said significance coefficient as a function of the halftone value for the image at that neighborhood pixel and of the baseline value for the individual pixel.

5. A method according to claim 4 in which the baseline value for the individual pixel is derived by low pass filtering of the halftone image.

6. A method according to claim 5 in which, for each individual pixel, the significance coefficient for each neighborhood pixel is a decreasing function f(v) of the absolute difference (v) between the halftone value at that neighborhood pixel and the baseline value for the individual pixel.

7. A method according to claim 6 in which f(v) is a non-linear function.

8. A method according to claim 6 in which f(v) is a continuous function.

9. A method according to claim 8 in which f(v) is a function of the form $f(v)=a(1-v/b)^k$ where a and b are predefined numbers and k is a predefined integer.

10. A method according to claim 8 in which f(v) is a function of the form $f(v)=a(1-v/b_1)\,(1-v/b_2)\,..(1-v/b_k)$, where a is a predefined number, k is a predefined integer, $\{b_k\}$ are a set of k predetermined numbers.

11. A method according to claim 2 comprising a further step of forming an enhanced reconstructed image as a linear combination of said reconstructed image and a continuous image derived from said halftone image by a second image reconstruction method.

12. A method according to claim11 in which said second image reconstruction method is a low pass filter.

13. A method for converting a halftone image having a binary value for each of a plurality of pixels, into a reconstructed image which for each of said pixels takes more than two values, comprising for successive individual pixels:

defining a set of neighborhood pixels of the individual pixel, the set of neighborhood pixels including the individual pixel and additionally a plurality of pixels proximate said individual pixel;

deriving for each pixel of said first neighborhood, a respective significance coefficient; and

deriving a first reconstructed value of the individual pixel as a sum over the neighborhood pixels of a product of the halftone image value at that neighborhood pixel with the respective significance coefficient of that neighborhood pixel; and

M further steps, m=1,..., M ($M \geq 1$), of:

for successive individual ones of said pixels:

rederiving a significance coefficient for each neighborhood pixel; and

deriving an (m+1)-th reconstructed value of the individual pixel as a sum over the neighborhood pixels of the product of the m-th reconstructed value at that neighborhood pixel with the significance coefficient of that neighborhood pixel.

14. A method for converting a halftone image having a halftone value for each of a plurality of pixels, into a reconstructed image which for each of said pixels takes more than two values, comprising:

preprocessing the halftone image by a filtering algorithm to derive a preprocessed image having a preprocessed image value for each of said pixels; and

for successive individual pixels:

(i) defining a set of neighborhood pixels of the individual pixel, the set of neighborhood pixels including the individual pixel and additionally a plurality of pixels proximate said individual pixel;

(ii) deriving for each pixel of the neighborhood, a significance coefficient; and

(iii) deriving the reconstructed value of the individual pixel as a sum over the pixels of the neighborhood of a product of the preprocessed image value at that neighborhood pixel with the significance coefficient of that neighborhood pixel.

15. A method according to claim 14 in which, for each individual pixel, said step of deriving a significance coefficient for each neighborhood pixel includes: deriving a baseline value for the individual pixel, and deriving said significance coefficient as a function of the preprocessed value for the image at that neighborhood pixel and of the baseline value for the individual pixel.

16. A method for enhancing first image having a first value for each of a plurality of pixels, into an enhanced image, comprising for successive individual pixels:

defining a set of neighborhood pixels of the individual pixel, the set of neighborhood pixels including the individual pixel and additionally a plurality of pixels proximate said individual pixel;

deriving for each pixel of the neighborhood, a significance coefficient; and

deriving the reconstructed value of the individual pixel as a sum over the pixels of the neighborhood of a product of the first value at that neighborhood pixel with the significance coefficient of that neighborhood pixel.

17. A method for enhancing a first image having a first value for each of a plurality of pixels to form an enhanced image, comprising:

preprocessing the first image by a filtering algorithm to derive a preprocessed image having a preprocessed image value for each of said pixels; and

for successive individual pixels:

(i) defining a set of neighborhood pixels of the individual pixel, the set of neighborhood pixels including the individual pixel and additionally a plurality of pixels proximate said individual pixel;

(ii) deriving for each pixel of the neighborhood, a significance coefficient; and

(iii) deriving the reconstructed value of the individual pixel as a sum over the pixels of the neighborhood of a product of the preprocessed image value at that neighborhood pixel with the significance coefficient of that neighborhood pixel.

18. A computer program product which is readable by a computing device to cause the computing device to perform a method according to claim 1.

19. A computer program product which is readable by a computing device to cause the computing device to perform a method according to claim 2.

20. A computer program product which is readable by a computing device to cause the computing device to perform a method according to claim 13.

21. A computer program product which is readable by a computing device to cause the computing device to perform a method according to claim 14.

22. A image enhancement apparatus for converting a first image into an enhanced image, comprising a processing device having:

an image receiver for receiving said first image;

and an image processor for:

for each pixel, defining a respective neighborhood containing that pixel and other pixels;

in a first iteration, obtaining for each individual pixel a continuous value as a weighted sum of the values of the pixels of the first image in the neighborhood of the individual pixel, the weighting values being derived from the values of the first image; and

in further iterations, obtaining for each individual pixel a continuous value as a weighted sum of the continuous values of the pixels in the neighborhood of the individual pixel obtained at the previous iteration, the weighting values being derived from the continuous values obtained in at least one previous said iteration.